H->WW: STUDY OF LOWPT EXCESS

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Outline

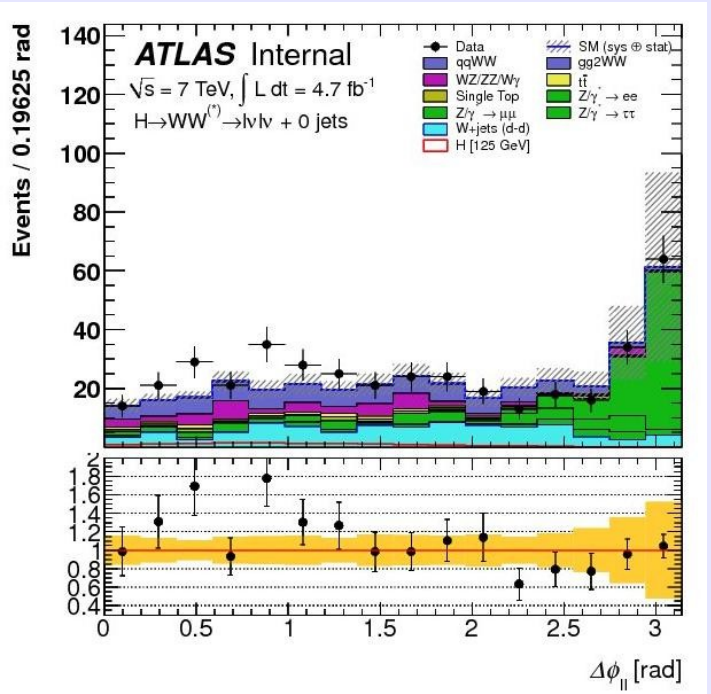
- The excess in the low lepton Pt analysis
- Comparison of signal and background kinematic distributions
- Flavor dependence of excess
- Summary

STUDIES of LOWPT $\Delta\Phi_{ll}$ EXCESS

LowpT analysis not included in present paper, because of an excess in the $\Delta\Phi$ distribution which is being investigated. It appears early in the event selection for the njet=0 sample

Corrinne March 14 Summary (Ischia Workshop)

- How significant is this? Consider integral of first 9 bins ($0 < \Delta\varphi < 1.77$, close to cut value)
  - → *Predict 169.4 events, observe 211*
  - → *stat-only p-value 0.0011*
  - → *add W+jets systematic → 0.03*
  - → *add all BG syst. → 0.18*
  - → *add signal at 125 GeV → 0.43 (11 additional events)*
  - → …

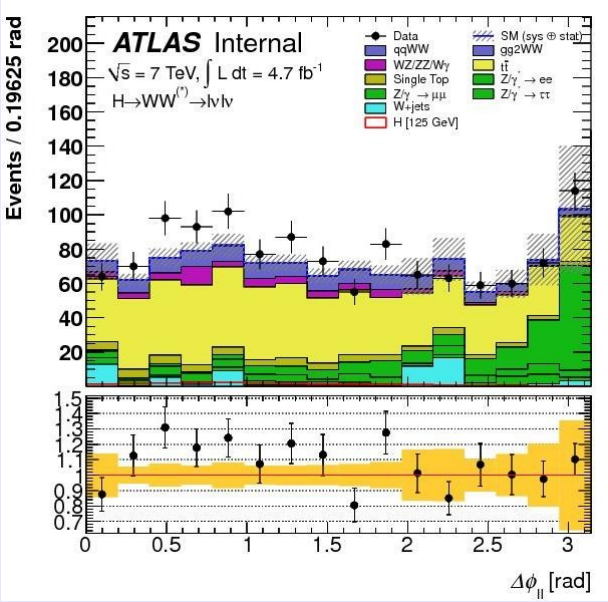


Recent studies by Antonio Boveia identified the sample where the excess happens: events with a subleading muon

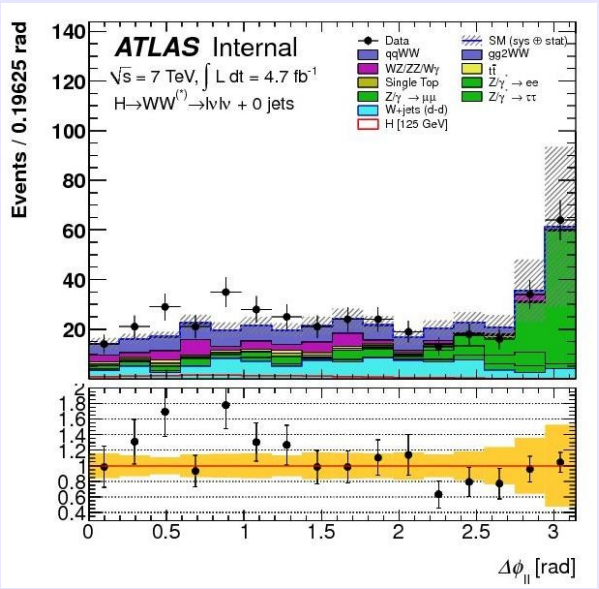
SEQUENCE OF $\Delta\Phi_{ll}$ PLOTS

The excess is seen at the pre-selection level (Cut 11) and persists through subsequent background reducing cuts

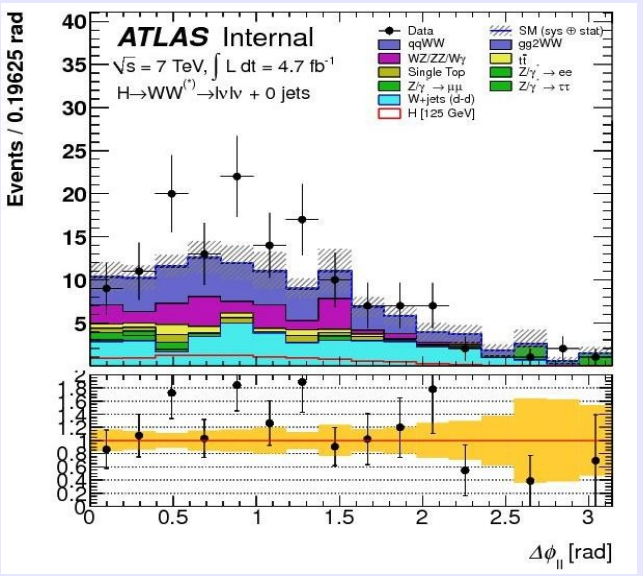
Cut 11 (preselection)



Jet Veto



Njet=0 final plot



H->WW->lvlv Low PT CutFlow

How significant is the excess?

	Signal [125 GeV]	WW	WZ/ZZ/Wγ*	ttbar	Single Top	Z/γ*+jets	W+jets(d-d)	Total Bkg.(d-d)	Seen
$E_{T,rel}^{miss} > 45,25$ GeV, Cut 11	21 ± 1	118 ± 14	52 ± 8	591 ± 31	62 ± 4	265 ± 116	113 ± 111	1201 ± 170	1235
0j: jet veto	14 ± 1	79 ± 7	39 ± 7	13 ± 3	8.9 ± 1.9	145 ± 68	92 ± 60	376 ± 85	406
0j: $m_{\ell\ell} < 50$ GeV	12 ± 1	50 ± 4	27 ± 6	6.5 ± 1.6	5.1 ± 1.2	123 ± 55	57 ± 40	268 ± 67	297
0j: $p_{T,\ell\ell}$ >45,30 GeV	9.8 ± 0.9	39 ± 4	20 ± 4	5.5 ± 1.3	4.7 ± 1.1	8.4 ± 4.1	37 ± 20	115 ± 14	143
0j: $\Delta\phi_{\ell\ell} < 1.8$	8.9 ± 0.8	35 ± 3	19 ± 4	5.2 ± 1.3	4.3 ± 1.1	4.3 ± 1.8	29 ± 16	96 ± 11	124
1j: exactly one jet	5.0 ± 0.4	25 ± 16	10 ± 7	102 ± 37	27 ± 9	81 ± 39	21 ± 26	266 ± 107	316
1j: b-jet veto (25 GeV, 80% eff)	4.6 ± 0.4	24 ± 14	9.5 ± 5.8	29 ± 13	8.7 ± 3.8	75 ± 36	20 ± 23	165 ± 72	217
1j: $p_T^{tot} < 30$ GeV	3.2 ± 0.6	17 ± 5	8.0 ± 5.6	13 ± 4	4.3 ± 1.5	33 ± 10	13 ± 9	89 ± 26	120
1j: $\Delta\phi_{\ell\ell} < 1.8$	2.2 ± 0.4	7.2 ± 2.4	5.5 ± 3.2	5.2 ± 1.7	2.3 ± 0.8	5.2 ± 2.9	3.9 ± 3.2	29 ± 9	40

After Jet Veto : 79 39 145 92 376 406

after $\Delta\Phi_{ll} < 1.8$: 35 19 4.3 29 96 124

	Total Backg	signal	Observed	Backg Hypothesis
After Jet Veto	376 ± 85	14 ± 1	406	good
with $\Delta\Phi<1.8$	170 ± 12	11 ± 1	212	excess too large 41 ev, expect 11
After all cuts ($\Delta\Phi<1.8$)	96 ± 11	8.9 ± 0.8	124	excess 28 ± 12 28 ev, expect 9

H->WW->lvlv Low PT Excess

What can the excess be due to?

- A Normalization factor of one of the backgrounds
- Mismodeling of one (or more) of the backgrounds
- Mismeasurement of one of the variables, not reproduced by the simulation

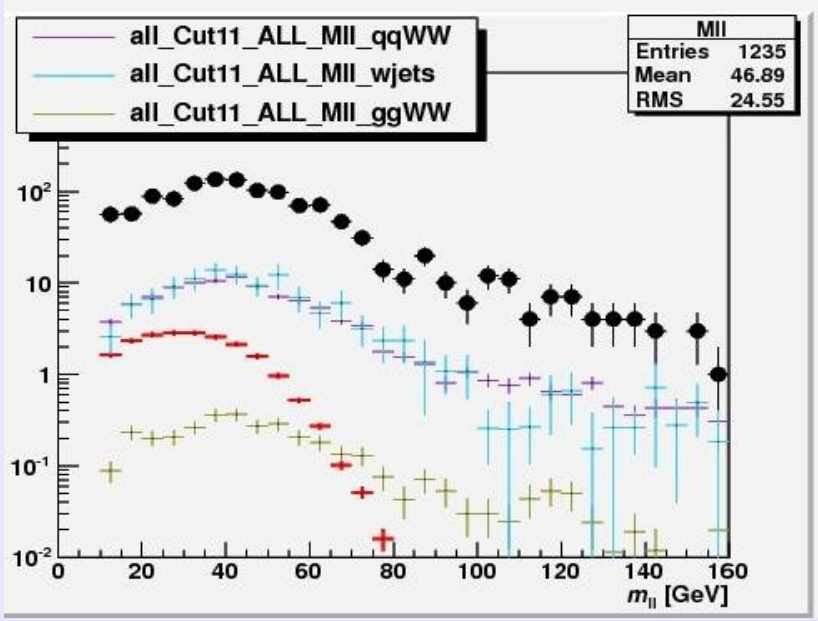
Regarding point 1, we can look at the $\Delta\Phi_{ll}$ dependence of each background, to see if any of them is enhanced in the excess region.

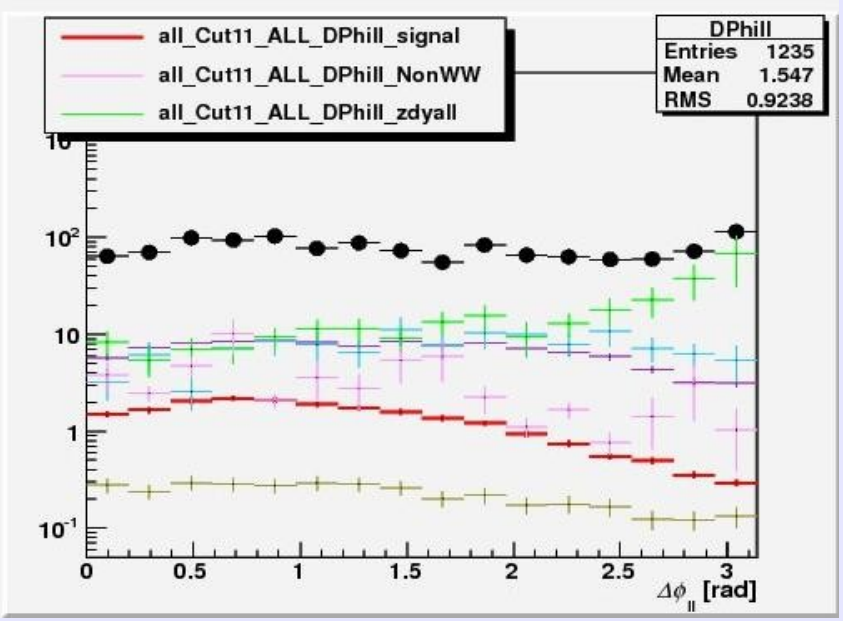
This is what we will look at in the next few slides:

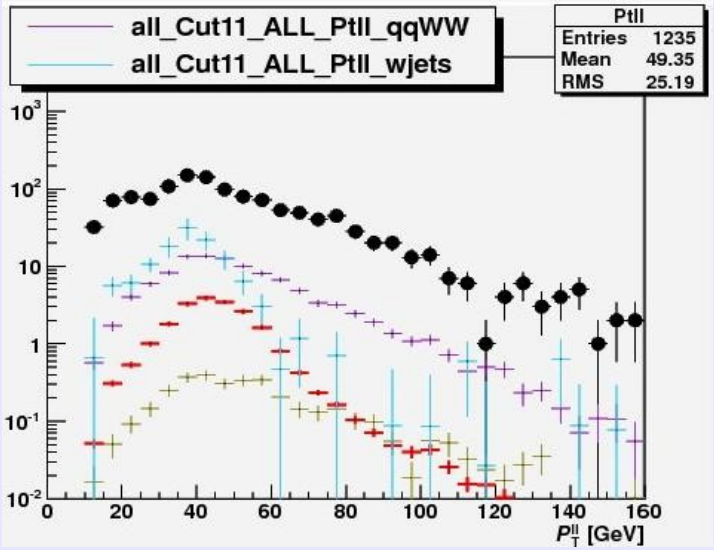
Note that background modeling for lowpT is same as for the nominal analysis

Some plots at Cut11 (preselection)

Not all backgrounds are included in these plots





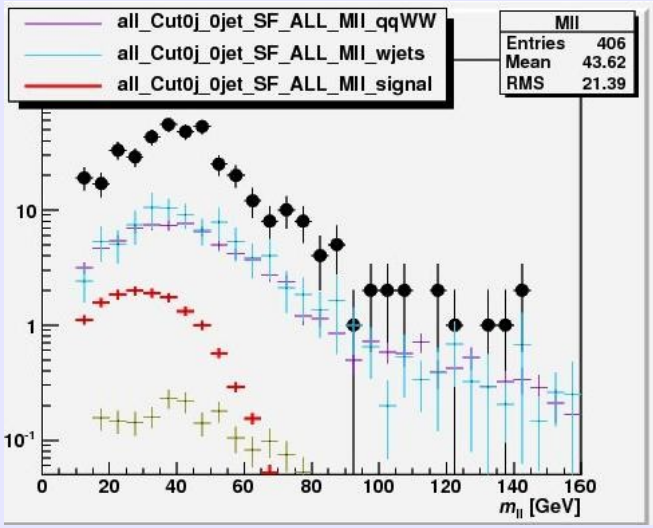


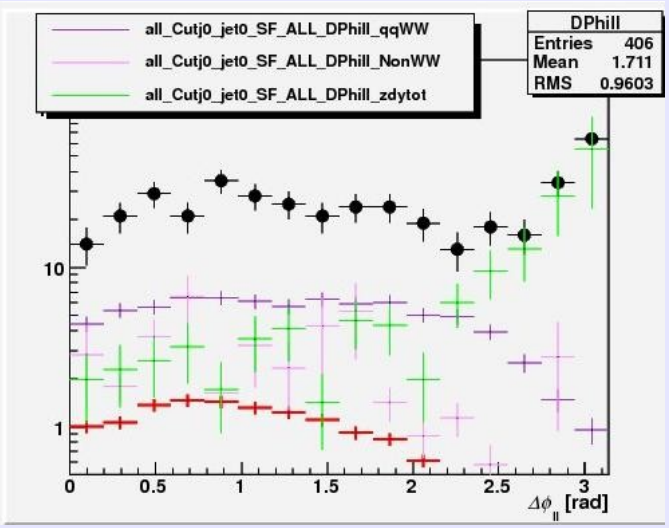
$\Delta\phi_{ll}$ plots: zdy, WW, NonWW are similar to signal for $\Delta\phi_{ll}<1.8$

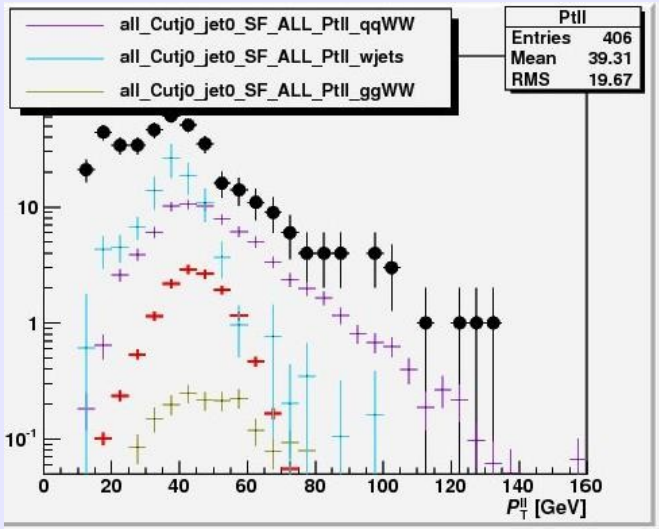
The qq->WW and gg->WW are shown separately to check their relative contributions at different cut levels. No change in the ratio observed.

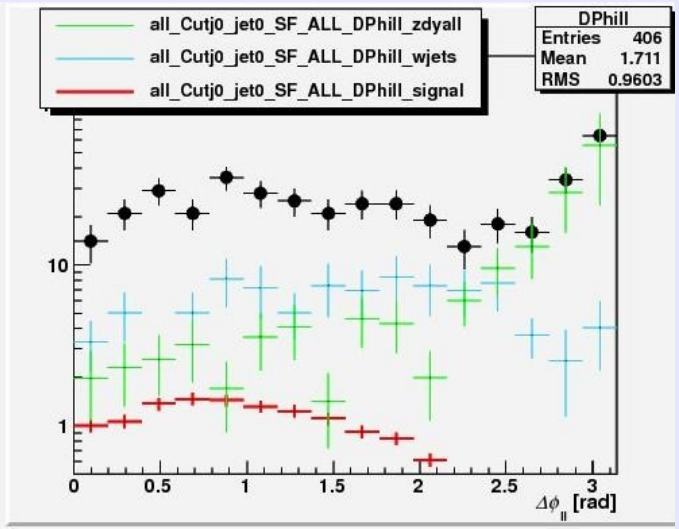
Plots at Cutj0_0jet (Jet Veto)

The two ΔΦ plots have different backgrounds .
Not all background are shown on the left plots







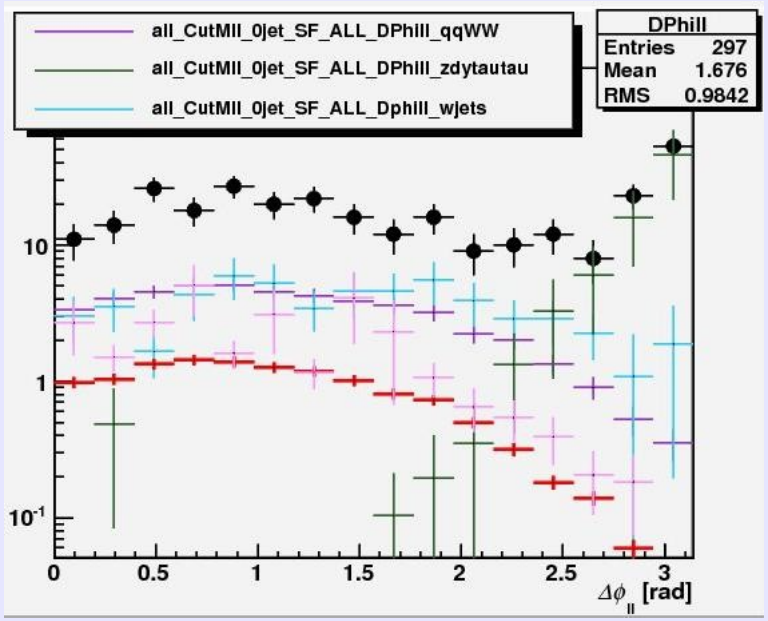


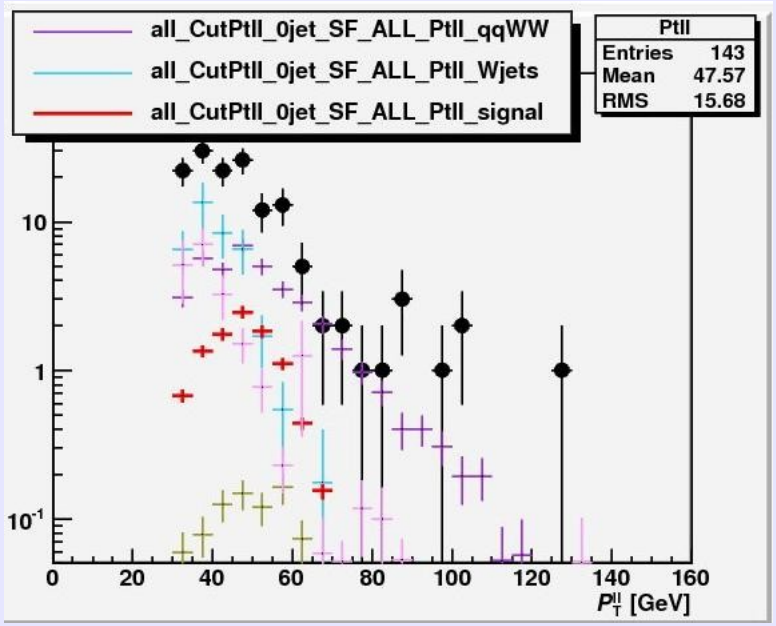
Note that:

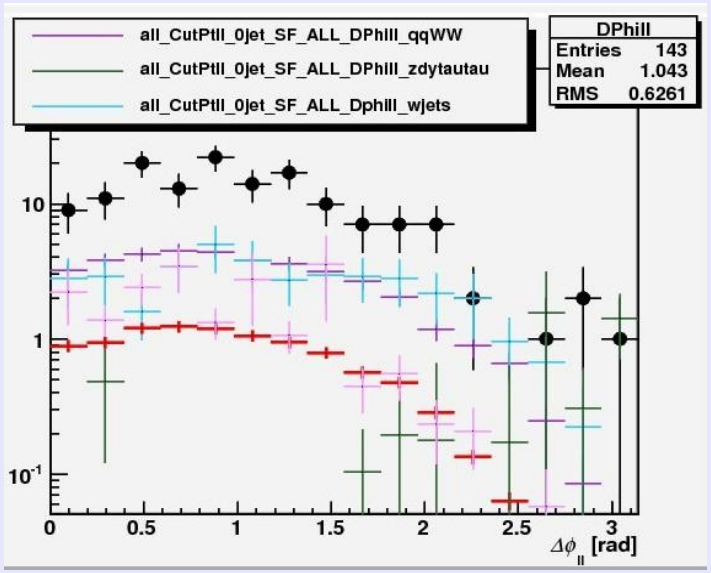
Zdy is now smaller than W+jets and WW for Δ Φ <1.8

Δ Φ for W+jets and WW are not very different from the signal (within the poor statistics)

Some Plots after the Mll, Ptll Cuts







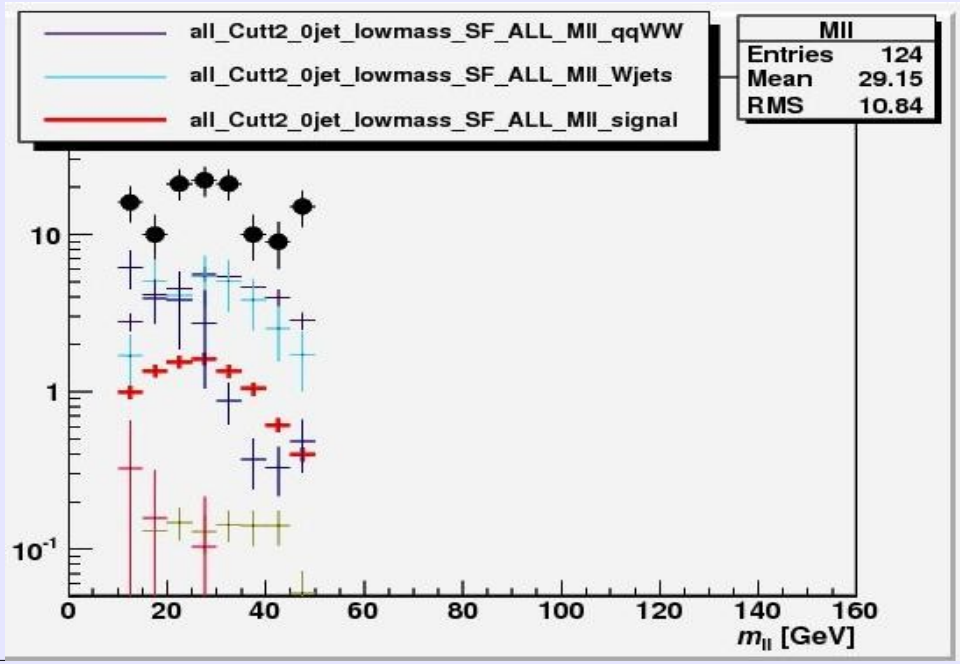
The Pt_{ll} cut has reduced the sample from 297 events to 143 events.

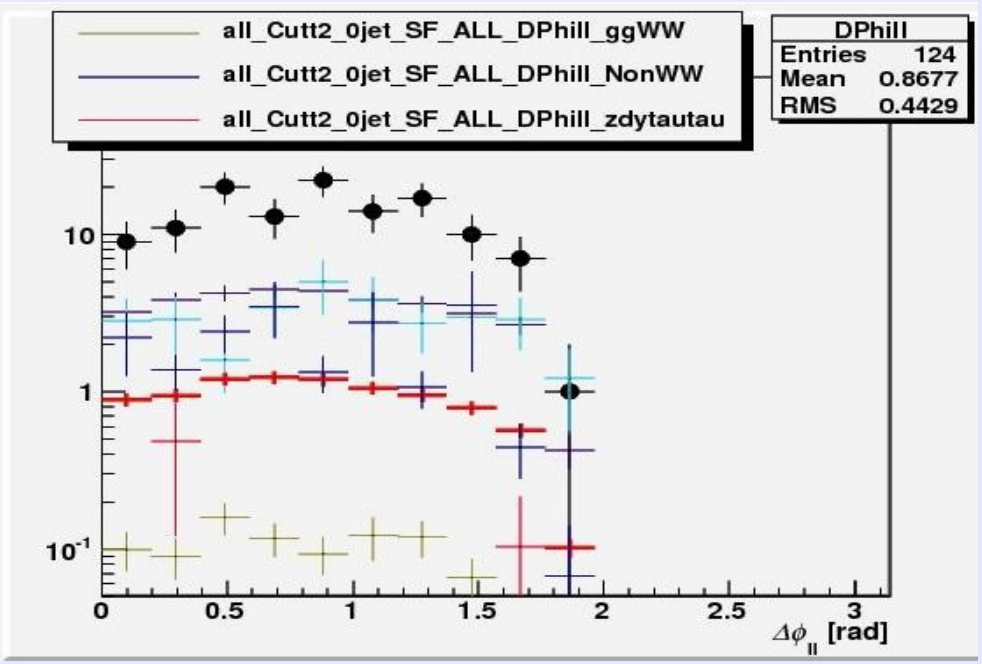
Most of the events removed with this cut are in the $\Delta\phi_{ll}$ region above 2.0.

Two plots at Cutt2

Here we see (right plot) that the W+jets,the WW and the NonWW backgrounds all, have the same shape as the signal. A normalization problem of one of them could accommodate the excess. This is probably already known.

Z->tau tau shown in this plot. This is obtained with teh collinear Approximation at the moment. Better modeling is being contemplated.





Flavor Dependence of Excess

Need to understand how Antonio's break trough (contamination of the subleading muons) enters into the excess.

Cutflow for different flavors

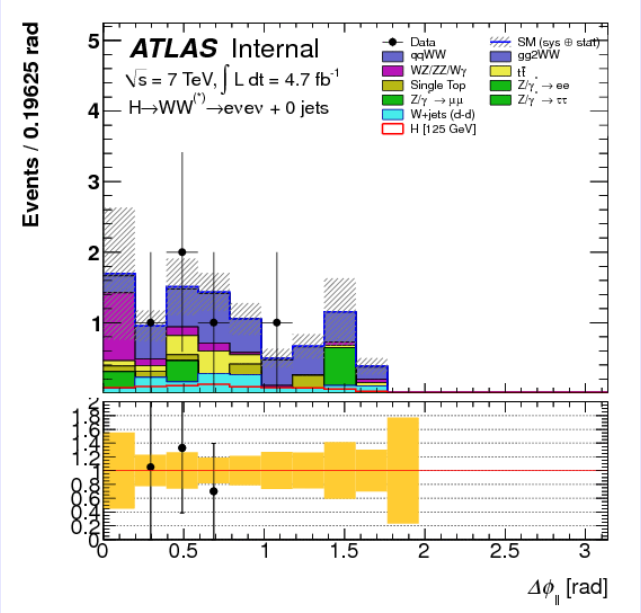
Lepton channel	ee	$\mu\mu$	eμ	all
Cut 11				
signal	2.2 ± 0.2	5.1 ± 0.3	13.3 ± 0.9	20.6 ± 1.3
Total Back	159 ± 24	271 ± 33	770 ± 114	1201 ± 170
observed	144	263	828	1235
Jet Veto				
signal	1.4 ± 0.1	3.3 ± 0.3	8.9 ± 0.8	13.6 ± 1.2
Total Back.	41 ± 9	80 ± 15	255 ± 63	376 ± 85
observed	43	81	282	406
$P_{T,\mu} > 45,30$ GeV				
signal	0.76 ± 0.08	1.6 ± 0.2	7.5 ± 0.7	9.8 ± 1.9
Total Back.	9.7 ± 3.1	15 ± 2	90 ± 10	115 ± 14
observed	6	20	117	143
Final Sample, with $\Delta\Phi < 1.8$				
signal	8.9 ± 0.8	0.7 ± 0.1	1.6 ± 1.1	6.6 ± 0.6
Total Back.	9.3 ± 3.0	14.2 ± 2.3	73 ± 8	96 ± 11
Observed	5	**19**	**100**	**124**

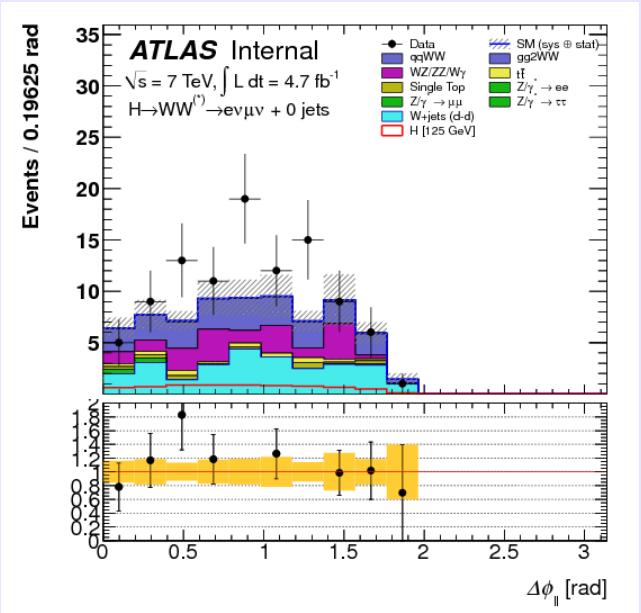
excess

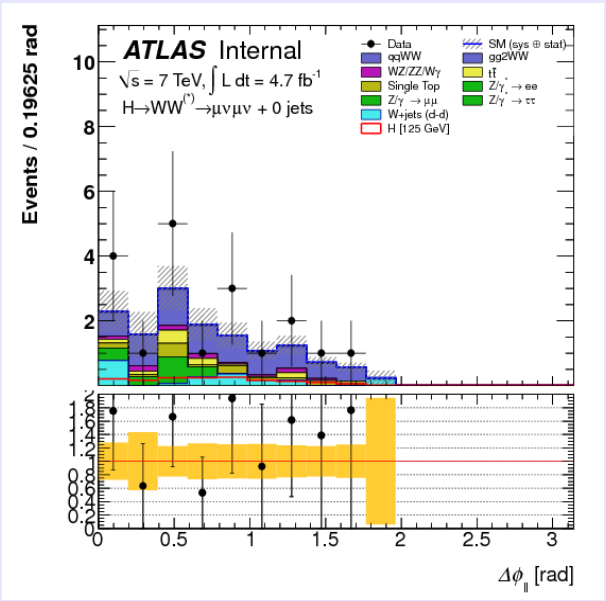
excess

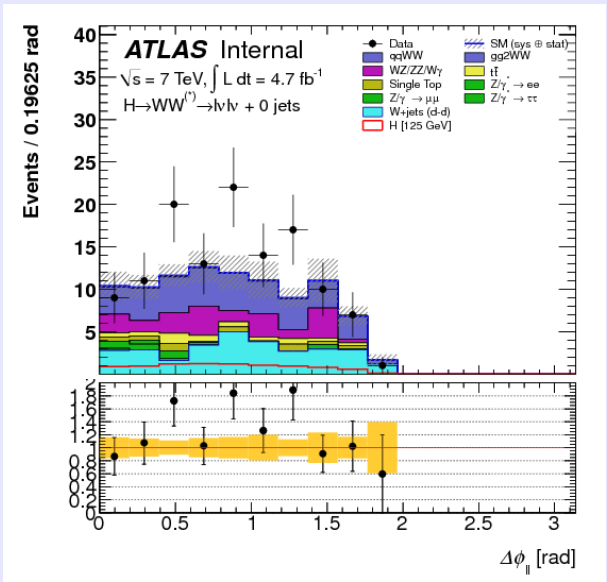
No excess in ee, excess in both eμ and μμ

FINAL PLOTS for ee, μμ, eμ, all









Low statistics,but

The ee plot is consistent with no excess.

Plots with muons show excess.

Summary

Looked at shapes of of the $\Delta\phi_{ll}$ distributions for different backgrounds to see if any of them expects an enhancement where we see the excess.

Turns out that: WW, W+jets and NonWW backgrounds (with present statistics) have a distribution not too different from the signal in the $\Delta\phi_{ll} < 1.8$ region (slide 9).

The cut flow for different flavors shows the same trend seen by Antonio, but not as pronounced because he split the e-high μ–low and the μ-high e-low samples.

More studies to follow